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ABSTRACT

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Toward Conceptualization of Learning Processes in the College Classroom II: Considerations from Operant and Social Learning Theory

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The Operant Model

A survey of the indexes for Psychological Abstracts through 1958 yields no references by title to applications of techniques derived from the operant "camp" of behavioristic psychology to the college classroom. The general lack of research on teaching was noted by Beck and Shaw (1960), who have observed:

> The study of the psychology of teaching is apt to involve disappointment. The great number of studies in human learning generate the expectation of a speedy introduction to important principles of practical training. Nevertheless, it is apparent that, although a great deal is known about the many variables and conditions that affect learning, little is known about applying these to promote efficient training (p. 543).

Beck and Shaw's statement requires some modification because of the work in the decade since it was made. During this period, there has been much effort in attempting to extend the methodology and principles of operant conditioning from animal laboratories to "real, human" problems. This endeavor has been primarily within the "Skinnerian school" and is manifested in education by "programed instruction" and "teaching machines." The earliest effort in this area was made by Skinner and his colleagues (Skinner, 1958; Holland & Skinner, 1961), but was intimated by Skinner as early as 1948 (Walden Two).

In spite of the rapid growth in this area since Beck and Shaw's (1960) statement, there remains much reason for such "disappointment." As Lloyd and Knutzen (1969, p. 125) point out, the use of programed materials has been widespread, but has gone little beyond the use of programed textbooks (cf., Lumsdaine, 1964; Gagné, 1965). Several volumes have dealt with programed instruction (cf., e.g., Lumsdaine & Glaser, 1960; Glaser, 1965; Calvin, 1969), yet applications to the college classroom of operant techniques have been limited almost exclusively to programed textbooks. This limited use suggests a need to specify the foundations and mechanisms in the application of the operant technology to the college classroom, so that these techniques may be more readily and widely applied.

In what follows, the attempt is made to (1) specify and elaborate the "theoretical" foundations of operant techniques; (2) review research in programed instruction and its implications; (3) review the literature in which specific applications to the college classroom of operant techniques have been reported; and (4) suggest some implications for future research in this area.

Theoretical Foundations

The general procedures employed in the conditioning of operant behavior (i.e., behavior by which the organism modifies or mani-

pulates his environment) have been set forth by many authors, but most extensively by the major proponent of this approach, B. F. Skinner (cf., e.g. Skinner, 1953; Skinner, 1963). In this section, the general procedures applied in operant conditioning are presented; also, procedures which are similar and aimed specifically at education and programed instruction are discussed.

Generally, five "steps" are delineated in the process of conditioning an operant (behavior); (1) the final desired outcome is specified; (2) the pre-conditioning level of this operant is measured; (3) the appropriate reinforcers, discriminative stimuli, and contingencies of reinforcement are specified; (4) a suitable "learning space" is established; and (5) the desired behavior is "shaped up" and brought under the control of the previously specified discriminative stimuli and contingencies of reinforcement. The order of these "steps" is not necessarily fixed. For instance, step (2) above may be better placed after (3) and (4) in specific situations; steps (3) and (4) might also be reversed where appropriate. In addition, the final behavior is assessed to determine to what extent the "desired outcome" was accomplished.

In specifying the "final desired outcome," the experimenter must define what behavior (specifically, operant) is to be the end-

product of this conditioning. In defining the operant, the measures by which the success of the conditioning is determined are also specified. As an example, in a typical conditioning study, an experimenter may have decided to establish a color discrimination in a pigeon. In such a task, the pigeon is to exhibit an operant of pecking a key of only one color and not another. In defining the final outcome, the experimenter also specifies the criteria of learning. That is to say, the measures whereby the operant is said to be conditioned or not are stipulated. In the present example, the experimenter may be satisfied that conditioning has taken place if the pigeon pecks the white key only 90% as often as the red in a 60-minute session.

In determining the "pre-conditioning level" of the operant, the experimenter is interested in the probability (or, operationally, the frequency) of the response in the organism's existing repertoire of behavior. In so doing, the "base rate" for this particular operant of the specific organism in the given situation is defined, against which the final outcome of conditioning can be compared. In the example of conditioning a pigeon to discriminate between a red and a white key, this step is carried out by observing the frequency of the pigeon's key-pecking behavior prior to

any experimental manipulations. In addition to determining the base rate of the operant in question, in this step the experimenter takes note of behaviors which could be components of a more complex operant (i.e., a "chain" of responses) which the experimenter might wish to establish in the behavior repertoire of the organism and for which the base rate is virtually zero. In the example of the pigeon color-discriminating, if the desired operant were a circle turned in the clockwise direction before pecking the red key, the experimenter would note in the base rate determination those behaviors which were emitted frequently and could be components of the turning behavior, such as tilting the head in the clockwise direction.

The third step noted above is most complex and deals with "motivational" variables of learning, as well as the physical limits of the organism. In specifying the appropriate reinforcers, the experimenter must be aware of or control the physiological state of the organism. Motivation for learning (performance) is typically operationalized by depriving the organism of some necessity of life (e.g., food, water), but not to such an extent as to impair the organism. Yet choosing, as a reinforcement of the food-deprived pigeon in the previous example, a pellet of dried meat would be inappropriate. In addition to reinforcement

delivered appropriately to meet deprivation, other types of reinforcers may be useful. Secondary reinforcers, when they can be observed or established for the organism, may be more appropriate in certain conditioning situations. (This is apparent in considering the complex behavior of students controlled by grades or "being right"; a point considered in greater detail below.) In the example of the color-discriminating, clockwise-turning pigeon, many circles may be turned just to be able to peck the red key (the key becoming red only after n circles are turned by the pigeon).

In specifying the discriminative stimuli, under the control of which the experimenter wishes to bring the operant, again the physiological limits of the organism must be recognized. To require the pigeon in the, by now well-used, example to discriminate between two shades of red, closely spaced on the spectrum, would be nearly an impossible task to learn. In addition, the discriminative stimulus may vary in its appropriateness to the task. (This point can be better exemplified in considering educational uses of operant techniques discussed below.)

The specification of the contingencies of reinforcement includes two primary considerations: (1) the interval between

operant termination and the presentation of reinforcement (termed "delay of reinforcement") and (2) the number of operants required prior to reinforcement ("schedules of reinforcement"). In this regard, the physical limits must be considered: a delay of reinforcement of five minutes is likely to have little effect on the color-discrimination operant of the pigeon, yet a grade of 129/150 may have powerful effects for a student several weeks after the behavior has been emitted. Likewise, expecting a pigeon to emit ten circle-turnings for the first reinforcement is unreasonable. Both the delay and schedules of reinforcement have been extensively researched in the laboratory (cf., Ferster & Skinner, 1957), and hence, the experimenter in the laboratory can readily find guide lines for this step. (This procedure when applied in the educational or therapeutic setting has been termed "contingency management," by some authors; see below. Guide lines for the classroom, however, appear not to be so readily available).

In establishing a "suitable learning space," the experimenter attempts to control as many as possible of the variables which may impinge on the organism and interfere with conditioning. In addition, the environment most conducive to learning

is sought. This includes making the methods of response and reinforcement convenient to the organism. In the example of the discriminating pigeon, this is generally accomplished by utilization of an operant conditioning apparatus (the so called, "Skinner Box").

Finally, the experimenter shapes up the specified operant by reinforcing successive approximations of the behavior. In addition, the behavior is brought under the control of the specified discriminative (eliciting) stimulus and contingency of reinforcement. Shaping is accomplished through the utilization of small increments in moving from more simple to more complex behavior, in that the organism is first reinforced for gross approximations of the desired operant and then only for finer and finer approximations. Responses which were initially sufficient for reinforcement are subsequently not reinforced. By requiring one simple behavior to follow another, prior to reinforcement, complex behavior patterns (the whole of which may be termed an operant) are established, through chaining. In bringing behavior under the control of specific (sets of) stimuli and in establishing schedules of intermittent reinforcement, the organism is reinforced only under certain conditions and only after a certain number of operants have been emitted.

That is the response probability for the specified operant comes to approach 1.0 under certain states, and 0.0 under others. Measures like rates of responding are influenced by the schedule of intermittent reinforcement (i.e., the number of operants required before reinforcement).

Operant Foundations in Education

Several authors have delineated approaches to applying, in the educational situation, operant techniques similar to those discussed in the preceding section. Reviews by Barlow (1962) and Gagné (1965) represent and summarize such work.

Barlow has maintained much of the language of "Skinner's 'operant' psychology," yet taken it from the laboratory setting (as is exemplified in the preceding section) and placed the emphasis on the classroom. Barlow states,

> The task of the teacher is to (1) determine the current discriminative repertoire and effective reinforcers for the potential students; (2) carefully specify the desired terminal behavior and contitions under which this behavior is appropriate; (3) evoke and reinforce typical current behavior that is relevant in order to "dipper" or "magazine" train the student; (4) carefully sequence SDs [discriminative stimuli] and reinforcement in order to shape the behavior of the student until the desired behavior is emitted in the presence of SDs typical of the natural practical environment in which the behavior is appropriate; (5) complete the sequence in such a manner that the new

> behavior will be intrinsically reinforced and maintained after the sequence is completed (p. 403).

It should be noted that, in addition to some differences in the order of the steps outlined in the description of the operant procedures presented initially above and Barlow's, there are some differences in emphasis (if not content). It should be helpful to indicate just how Barlow's scheme relates to the more general one outlined previously. Barlow's first point corresponds roughly to the third point in the general scheme outlined above, that is specifying the appropriate reinforcers, SDs, and contingencies. In addition, this step of Barlow's scheme implies the determination of base rates which is the second point in the general operant procedure. Barlow's second step also implies (3) of the general scheme, as well as the specification of the desired final outcome, (1) of the general scheme. The "general conditions under which this behavior is appropriate" can be taken as the relevant discriminative stimuli and contingencies of reinforcement. Barlow's third and fourth points may be seen to correspond with the fifth point of the general procedure, shaping and establishing contingencies. The fifth point of Barlow's scheme is implied in (5) of the outline of the general procedure: "intrinsically reinforced and maintained" may be taken to correspond to

"brought under the control of the previously specified discriminative stimuli and contingencies of reinforcement." Barlow's scheme apparently does not specifically consider step (4) of the general procedure for operant conditioning, the establishment of a suitable learning space. It is, however, implicit in Barlow's whole description and most clearly implied in (3).

Gagné (1965) has emphasized the importance of specifying the outcomes of conditioning and the conditions for the behavior to be emitted (Barlow's second step). In addition, to the necessity of this step apparent in the statement of the operant approach in the laboratory (step (1) in the general scheme), he indicated some other and perhaps more practical considerations. To Gagné, the specification of terminal behavior desired by the teacher is essential so that the "instructional designer" may know the nature of what is to be learned. That is to say, the "instructional designer" must know the nature of the terminal behavior so that he can correctly design the terminal stages of his program. This depends on the specification by the user of a program (teacher) of "what the learner is expected to be able to do" having gone through instruction. It is only with such a criterion that the success of the program can be measured. Clearly, this terminal

behavior must be specified as an overt performance in order to provide a suitable criterion. In addition to determining the terminal sequences of the program, Gagné points out that the specification of outcomes in overt behavior allows the programer to make inferences about behavior modifications to be made through the program (pp. 23-24).

Gagné notes two more reasons for specifying the desired outcomes of conditioning in terms of overt behavior. One such specification allows the evaluation of the effectiveness of the program in comparisons of the effectiveness between programs. This is so because the specification of overt terminal behaviors meets the requirements of reliability and measurement. Finally, Gagné suggests that the most important function of specifying outcomes of conditioning is the provision of a basis for the shaping of behavior (cf. steps (3) and (5) of the general scheme above). Distinctions among the class of behavior to be established may serve as a basis for modifying previous patterns of behavior. Different classes of behavior require the application of different conditions for learning (p. 25). For example, the learning of a class of behaviors such as ethical behavior can be expected to

take place under different conditions (e.g., different contingencies and reinforcers) than the learning of a class of behaviors such as basket making. In Gagné's preceding treatment "user" and "educational designer" are distinguished. Often, however, it is the case that in the ad hoc use of operant techniques in the classroom (the construction of a program or writing of a program or writing of a programed text), these two "technicians" are the same. Nevertheless, it should be emphasized that the specification of clearly defined end-products for the conditioning remain essential.

Gagné emphasizes one more role for the specification of outcomes or "defining of objectives"; this has to do with the role of reinforcement in applying operant techniques to human behavior. The matching of behavior to specified outcomes (i.e., "being correct") appears to be a powerful reinforcer of human behavior (Gagné, 1965, p. 26). However, Gagné adds that "reinforcement" has not been practically defined, beyond the conceptual definition that a set of conditions coincident or closely subsequent to a behavior which appears to increase the probability of that behavior is termed reinforcement. Reinforcement is then taken to mean in programed instruction the learner's matching of his

own response production to a response which is indicated as correct (p. 27).

For the most part, to this point, the elaboration of Barlow's scheme has been limited to his second point and to the additions to it suggested by Gagnè. Skinner (1965) has written an article which suggests some further clarification of Barlow's outline and provides some additional translation from the statement of operant procedure in the laboratory to the application of these procedures in the classroom. Skinner offers the following elaboration:

> An important contribution of operant research has been the so-called "programing" of knowledge and skills--the construction of carefully arranged sequences of contingencies leading to the terminal performances which are the object of education. The teacher begins with whatever behavior the student brings to the instructional situation; by selective reinforcement he changes that behavior so that a given terminal performance is more and more closely approximated. Even with lower organisms quite complex behaviors can be "shaped" in this way with surprising speed; the human organism is presumably far more sensitive (pp. 6-7).

The notion, contingency, implies both reinforcement schedules and sequences of discriminative stimuli; behavior is brought under the control of both. As Barlow suggests, "weaning" from the program is essential also, so that the behavior is maintained by the

appropriate schedules and reinforcers and discriminative stimuli in the "real world."

Reflecting the emphasis on specification of overt behaviors as the terminal outcomes of conditioning made by both Barlow and Gagné, Skinner (1965) also emphasizes the equally straightforward (overt) function of the program (or teacher): "The task of the teacher is to bring about changes in the student's behavior. His methods are equally conspicuous: he makes changes in the environment. A teaching method is simply a way of arranging an environment which expedites learning" (p. 13). This is the implication of the third and fourth points in Barlow's scheme, but it more clearly reflects the fourth point in the discussion of operant techniques in the laboratory, that is the establishment of a suitable "learning space." In addition to manipulation of contingencies of reinforcement and discriminative stimuli, an environment "conducive to learning" (i.e., a "learning space") is needed.

Skinner also suggests a dichotomy of the role which operant procedures play in the educational setting. As he views this role of "programing," the arranging of contingencies of reinforcement by the teacher is to establish new forms of response, such as a handwriting and verbal and non-verbal behaviors as in sports,

arts and crafts, is fairly straightforward. However, the manipulation of contingencies to bring existing behaviors under new stimulus controls, such as with intellectual and ethical self-control has not been so widely attempted, but requires the application of the same principles (1965, p. 13). This discussion corresponds roughly to Barlow's fourth point, but also incorporates part of Barlow's final point.

The second half of Skinner's dichotomy of the role of operant procedures in education completes the fifth step of Barlow's scheme and reflects the "motivational" aspects in the preceding treatment of laboratory operant techniques. Skinner emphasized the role of schedules of reinforcement in suggesting that "a second kind of programing" results in the maintenance of the strength (or probability) of a student's behavior. The form of the response and stimulus control are not altered but the likelihood of response is increased. The introduction of new reinforcers or increasing the effectiveness of old ones can strengthen behavior, as in Skinner's example of providing a student better reasons for getting an education. He adds that another possibility is suggested by the experimental analysis of behavior: available reinforcers may be scheduled more effectively. Appropriate terminal schedules will yield a

"motivated" student, or one who is "interested," "perservering," "curious," and "industrious"; but less stringent schedules are required first, in order to maintain the desired behavior at every stage. Skinner stresses that, "The programing of schedules of reinforcement is a promising alternative to the aversive control which, in spite of repeated reforms, still prevails in educational practice" (1965, pp. 13-14).

At this point, the juxtaposition of the laboratory techniques of operant conditioning and of the description of these techniques in the classroom is completed. With the theoretical foundations of operant conditioning in education having been delineated, it is now in order to consider the relevant literature on research and applications of operant techniques in the college classroom. The literature dealing with the application of operant techniques to college teaching is dichotomized in what follows, for clearer presentation. In the literature, applications are reported which are concerned primarily or exclusively with course content (e.g., using a programed text); this is referred to as programed instruction in this conceptual dichotomy. In the second type of application, the operant techniques are used in the total classroom presentation and activities, rather than just in the course content,

and programed readings may or may not be used; this is termed contingency management. The second approach attempts to control much more of the student's activity than the first. The use of the term, programed instruction is somewhat confusing in the literature; it refers either to specific course or content programs, such as a textbook or a teaching machine would present, or more generally to the wider use of operant principles in the technology of teaching. The latter use of the term is treated here as contingency management.

Before considering the research literature, a possible source of its apparent sparseness is considered. It appears very curious that an approach growing out of a history of fervent research and an advanced methodology (i.e., strict operationalism) evidences such a dearth of research. Skinner (1965, pp. 16-19) suggests a possible source of this sparseness; it may be in part a result of a "tradition" of research in education, which is somewhat antithetical to that implied by the operant approach. Under the influence of Thorndike's work in the measurement of mental abilities, research in education has neglected causal relationships in the processes of instruction and has emphasized the matched-group comparisons of various practices of teaching. The contribution

of the operant approach to the technology of teaching is the analysis of reinforcement contingencies and the effects of these manipulations on the behavior of individual students.

The orientation to research in education proposed by Skinner is the following: "In education, no matter how important improvement in the student's performance may be, it remains a by-product of specific changes in behavior resulting from specific changes in the environment wrought by the teacher. Educational research patterned on an experimental analysis of behavior leads to a much better understanding of these basic processes" (p. 17).

Research on Programed Instruction

Conceptually, the literature on programed materials in higher education can be considered under two major research questions. First, the specifications of operant techniques as particular programs can be compared with one another and with other educational approaches as to their effectiveness. Secondly, variables may be manipulated in research considering the effectiveness of a given program; other criteria, in addition to effectiveness, may also be of interest. Variables within the program itself, such as size of increments of

response required, number of items, nature of the reward, or variables which the learner brings into the learning situation such as "intelligence" or previous history of reinforcement may be considered. Typically, these latter variables are indicated by correlational measures such as achievement scores and grade point average (GPA).

The implication of Skinner's orientation, proposed above, is that research employing traditional measures (e.g., GPA) is inappropriate; emphasis should be placed on the "learning environment" (e.g., schedules of reinforcement). In spite of this suggested emphasis, the research tends to follow the traditional approaches, as is seen in the following discussion. In the topics considered below, no effort is made to comprehensively summarize research designs and "findings." The emphasis, rather, is to indicate the kinds of variables which have been of research interest, along with apparent limitations of such research.

Although research in this area could conceptually center on comparisons of various programs, the bulk of this limited research deals with comparisons of programed materials to traditional approaches in education. In addition to knowing the success of a program in bringing about the desired behavior or the success of one program compared to another, it may be useful to know what

changes are brought about in the student, perhaps in addition to those specified. Traditional experimental procedures (e.g., correlation) and formulation of designs (e.g., based on the insight of the teacher), typical in education research, are not sufficient for assessing the effectiveness of a program with individual students and rarely have directly resulted in improved practices (Skinner, 1965, pp. 16-17).

A study by Rawls, Perry, and Timmons (1966) compared "conventional instruction and individual programed instruction in the college classroom." "Programed instruction" in this study consisted of a commercially prepared programed text, while the "traditional' approach of lecture and assigned readings provided the second condition. The material to be learned was the physiological section of an introductory psychology course. Subjects, 21 pairs, matched on variables of sex, age, IQ, and formal training in biology, were tested immediately after the completion of the topic, and six weeks later were retested. The authors conclude that the programed instruction resulted in better long-term retention. This is exactly the kind of research, traditional in education, which was criticized above. The individual effects of the instruction are lost in a group means; whereas

the operant approach emphasizes the unique learning of an individual student.

A study conducted by McGrew, Marcia, and Wright (1966) evidences somewhat more research sophistication than that of Rawls, et at. (1966). In an effort to control for the differential practice possible in designs which compare traditional with operant approaches, these authors employed a "branching program" (i.e., when S gives a correct answer, he skips subsequent repetitive frames). Using an analysis of covariance of the test performance of 66 undergraduates, the authors conclude "that sheer repetition of material, regardless of the medium employed, is a significant factor influencing the outcome of comparative studies" (p. 505). These authors imply that in studies comparing operant with traditional approaches to education, there may be failure to control for possible differences in practice inherent in the techniques.

McMichael and Corey (1969) have also compared a traditional with an operant approach to teaching introductory psychology. Based on comparison of final examination scores, these authors concluded that the operant approach was superior. However, more interesting than this conclusion is the general use of

operant techniques beyond programed textbooks, known as "contingency management," which is considered more completely below (pp. 21-22).

As noted earlier, research on programing techniques in the classroom can take two tactics, conceptually. The majority of the research on the second question deals with variables students bring to the educational setting. The research on the variables within programs has had an extensive history of laboratory research (cf., e.g., Skinner, 1957). Hence, in the application of these techniques to education, much of this information is used rather uncritically.

Coulson and Silberman (1960) report a study in which some of these variables are discussed, yet the methods that Skinner has criticized, mentioned above, were used. Three independent variables were manipulated: response mode (multiple-choice vs. constructed response), increment between steps, and linear vs. branching items. An analysis of covariance compared pre-test and criterion test scores of two subject groups. Among other conclusions, these authors report the superiority of small steps for learning and no differences for the other two variables.

Representative of research on variables which the student brings to the operant situation are studies by Doty and Doty (1964) and Flynn (1966). The variables delineated in the first study were "GPA, creativity, achievement need, social need, and attitude toward programed instruction" (Doty and Doty, 1964, p. 334). They indicate that GPA and "social need" are important variables in the success of programed instruction. In the Flynn study, the effect of programed and "regular classroom procedures" were compared for "achievers" and "underachievers" (Flynn, 1966, p. 290). Flynn suggests that for "underachievers" the method has no effect on learning. For "achievers" operant techniques were superior.

There is some additional literature on programed materials in which specific program content and production, rather than research is the focus. Programing for college education (primarily writing textbooks) has covered a surprisingly wide range of topics and been carried on by a surprisingly wide range of "programers." Yet, the bulk of the work appears to be in introductory level psychology (cf., e.g., Barlow, 1962; Lloyd and Knutzen, 1969; McMichael and Cory, 1969). Williams (1967) reports on a program in which operant techniques were applied to the under-

graduate electrical engineering curriculum at Carnegie Institute of Technology. He concisely reviews the operant basis for the effort at Carnegie and the reasons for the interest in such an approach; he also concludes that the use of programed materials has promise for higher education. Two efforts which reflect wide interdisciplinary interest, using programing techniques in higher education have been reported. Gilbert (1969) comprehensively reports on the role of programed learning in the "university instructional services" at Northeastern University. The curriculum needs of undergraduates are referred by many departments to this service. Existing materials are appraised and new programs of instruction written and evaluated, where required. Here again, however, the use of operant principles is limited to the presentation of course content and so-called "hardware" (i.e., teaching machines and textbooks). Gilbert does not report the use of operant techniques to learning situations, other than content (i.e., contingency management appears not to be employed). A more limited but similarly interdisciplinary approach (both with regard to content and designers) is reported by Jacobson (1962-1963) at Hamilton College. Here programs were written by individual instructors of departments of French, German, mathematics, psychology and philosophy,

under the auspices of the Fund for the Advancement of Education. Jacobson notes the same sort of reasons for the interest in applying operant principles at Hamilton College as those suggested by Gilbert and in the preceding section, primarily those of effectiveness in providing individualized attention to students. The Hamilton effort is subject to the same limits as were pointed out for the Northeastern program.

The literature reviewed above appears to be representative of the research focusing on the use of programed materials in the (college) classroom. The need for such research has been succinctly summarized: "Research in teaching, of course, must not lose sight of its main objective: to make education more effective. But improvement as such is a questionable dimension of the behavior of either teacher or student. Dimensions which are more intimately related to the conditions the teacher arranges to expedite learning must be studied, even though they do not contribute to improvement or contribute to it in a way which is not immediately obvious" (Skinner, 1965, pp. 18-19).

Contingency Management in Higher Education

The literature which reports application of operant principles to the college classroom primarily concerns ad hoc attempts;

"ad hoc" in the sense that a specific program is written when a specific need arises. In addition, these programs are typically limited in the application of operant principles; most of the literature sampled reports the use of programed textbooks or of teaching machines, which is limited to a specific course content. The principles derived from "operant psychology" appear not to have been nearly as widely applied to the college learning situation as is conceptually possible. Very recently, however, some authors have reported what appears to be movement in this direction. This general approach often is termed "contingency management." The use of contingency management goes beyond the programed textbook or even the teaching machine in specifying behaviors throughout the course. Efforts which go beyond the application of operant principles to content materials alone are discussed below, even though they may not specifically use the term, contingency management.

In the course reported by Lloyd and Knutzen (1969), the authors utilized operant principles in much more of the total educational situation than just a programed text (Holland and Skinner, 1961). Initially, the terminal behaviors were specified for the students (in the outline of activities) and the existing contingencies (discriminative stimuli and reinforcers) were

evoked: students were told exactly what activities were required and at what deadlines for each grade. Activities were "programed" in the sense that material completed at one stage was prerequisite for the second. In addition, behavior was "shaped" in students by requiring greater initiative as the course progressed, and "weaning" was accomplished by bringing the behavior under the control of discriminative stimuli and contingencies of reinforcement outside the classroom setting (e.g., library study). Lloyd and Knutzen describe their aims as follows:

> The purpose was to arrange an environment for the student in which he would be performing many of the activities that psychologists perform. What he must do was specified at the beginning of the semester. Each activity was part of a sequence of activities which added up to a terminal performance that was equivalent to a given grade (p. 125).

Specifically, students were told at the first class meeting that the course was formulated in such a way as to demonstrate the use of operant techniques; the content of the course was the experimental analysis of behavior. Students were given an outline of activities and points alloted for each activity. Students were told that they could leave the course whenever they had obtained points sufficient for the grade they desired; and if they did not have points enough for the "A" grade, they could request an incom-

plete at the end of the term. Activities for each grade level, with the maximum and required points indicated in parentheses, were as follows: D (310 points)--class attendence (30,8), class participation (32,16), text review items (205,205), Walden Two (24,12), reading sheets (240,35); C (410 points)--movie reviews (36) or tape reviews (30,12 for either), taped discussion (26,6), C laboratory (18,12), reading sheets (360,40); B (510)--staff discussion (24,8), field trip (10,260 by week 8), B laboratory (18,12), circuitry (15,5), submit questions (12, for any), attend colloquia (10, for any), reading sheets (360,45); and A (600,500 by week 12)--field trip (10) or observe research (10,5 for either), major project (80,40). Students were required to repeat some activities until a specified number of points were obtained. This provides the reader a general outline for the course. In order to implement this course or a similar one, Lloyd and Knutzen's study should be read.

In addition to applying operant principles to the classroom, Lloyd and Knutzen also utilized an operant approach to the analysis of the data: each student's cumulative record of responses and reinforcements was plotted and considered. In such an approach, it has been observed that,

> The changes in behavior of the individual student brought about by manipulating the environment are usually immediate and specific; the results of statistical comparisons of group performances usually are not. From this study of the behavior of the individual student, the investigator gains a special kind of confidence. He usually knows what he has done to get one effect and what he must do to get another (Skinner, 1965, p. 19).

Another example of what has been termed contingency management follows a program first suggested by Keller (1966). The innovative research question of McMichael and Corey's (1969) study was "to test whether contingency management techniques could be used to teach the subject matter of a standard textbook" (p. 79). In this effort reinforcement contingencies were manipulated by requiring students to complete one section to criterion before moving to the next. Specifically, the course was devided into twelve units, for which reading from the text-book and a unit test were assigned. Students were required to make a perfect score on each unit test and student proctors were made available to help students prepare for repeating the tests. The study guide for the next section was not given to a student until he received the perfect score. Students were also told that the weekly lecture, demonstration, or film were to be attended by only those students who had passed the appropriate number of unit tests, but no effort was made to enforce this rule. These

authors used a "traditional" statistical design to compare terminal performances of control and experimental subjects, the latter performing better.

Another course which used programed materials for part of the course content and contingency management throughout the course is reported by Malott and Svinicki (1969). The course was an introductory course which had approximately 1,000 students enrolled each year. The course was designed to maintain the students' academic achievement, provide more personal instruction than the typical college classroom, reduce the costs of education compared to typical college courses, and allow the integration of theory and practice, that is to attempt to make the content "relevant" for the students; these are four areas in which typical courses appear to fall short. The initial focus of these authors was the delay of reinforcement, which tends to be large in a typical classroom. The reinforcement of being correct on an examination was nearly immediate because students took daily quizes, which were scored immediately upon completion. Students were offered remedial help and took the quiz until a perfect score was achieved. They also were required to complete four experiments during the term and rewrite reports

until the acceptable level was attained. Contingencies were specified so that if a certain number of points were not obtained by certain dates, students were required to drop the course. Reading materials, were programed; but lectures and discussion groups were also used and concentrated on making the information more relevant for the students. The authors made extensive use of "para-professionals," such as graduate assistant and undergraduate monitors or apprentices. The obtained level of achievement was stressed: "The students work about 12 hours per week for 3 hours of credit, 80% to 90% earn a final grade of 'A' and less than 2% receive an 'F.' This is the case even though high academic requirements are imposed" (Malott & Svinicki, 1969; p. 550).

Another introductory psychology course, which emphasized "individualized instruction" and was described by Ferster (1968), can be included under the contingency management heading. The primary tool in the course was an interview between two students, in which one exhibited the verbal repertoire he had acquired from the assigned reading, while the other listened without interruption. This procedure allowed immediate reinforcement to the speaker as he monitored his own performance. It also al-

lowed immediate reinforcement to the speaker as he monitored his own performance. It also allowed rehersal for the listener, who took notes and made comments after the interview. To complete the course, 59 acceptable interviews were required in 50 weeks. Students also took unit examinations ("written exercises") and a final examination, to provide information for the instructor's assessment of their repertoire. Unacceptable performances of both verbal and written exercises were repeated until criterion was reached. The reading materials were selected to cover topics in small segments; study guides, stating the objectives (verbal behaviors to be obtained), were provided for each segment. Interviews were limited to single segments. Ferster indicated the success of the course with the following: "of the 91 students who enrolled in the course, 81 remained after 2 weeks, and 79 completed the course for credit; 90% with A's, 4% with B's and 6% with C's" (p. 523).

It appears that none of the contingency management studies reviewed[1] have used all of the procedures of operant conditioning as they were initially outlined in this paper. If these authors have used all of the principles, it does not appear to be systematic, nor is it obvious in their reporting. A review of Bar-

low's scheme (presented earlier) with regard to how various authors appear to or fail to incorporate his various points should be productive. Suggestions as to why certain points appear not to be used are also included.

The first step of Barlow's scheme, the determination of the existing discriminative repertoire and effective reinforcers, appears to be accomplished by fiat in the studies reviewed. The failure of the operant approach to provide a means for such an evaluation for complex human behavior, on an individual basis, is one of the major criticisms of this approach developed later in the paper. In general, it appears that events such as being correct, receiving praise from the instructor, and receiving a high grade are reinforcing and effective for all students. Likewise, discriminative stimuli, those stimuli to which some behaviors are emitted and others withheld, are assumed to be the same for individual students. Such stimuli as an open book, a study table, or a teaching machine may or may not exist as SDs in individual student repertoires. Whether these reinforcers and SDs exist for every student in a given class and in equal strength is an empirical question, the evaluation of which is elaborated in the concluding section of the paper.

The specification of the desired terminal behavior, Barlow's second step, appears to be done with different degrees of care by different authors. In Lloyd and Knutzen's (1969) course, students were told what activities (behaviors) were to be emitted, to what criterion level, and when. McMichael and Corey (1969) appear not to clearly specify the terminal behaviors; the behavior of taking a test with a perfect performance appears to be fairly nebulous, if for no other reason than the number of operants which might be included. The effort by Malott and Svinicki (1969) can similarly be criticized. Although these authors did indicate additional behaviors (completing and reporting four experiments, as well as taking quizes), it is not clear that the desired terminal behaviors were carefully specified in advance. Ferster (1968) appears to have been somewhat more careful in the specification of some of the desired behaviors, by providing students with study guides, although the nature of the terminal performance of the interviewing and test-taking behavior does not appear to be specified.

Barlow's third step, the evocation and reinforcement of behaviors currently in a student's repertoire and useful in shaping, appears to present a problem to the operant approach

similar to that raised for Barlow's first step. The operant approach appears not to suggest methods for determining what is the current repertoire, including the relevant contingencies, for an individual in complex, human situations. In the laboratory, for simple behavior (including humans in some institutional situations, e.g., profound retardation), one need only to observe the organism to determine the base rate of the desired operant (step (2) of the laboratory procedures, outlined above; not readily apparent in Barlow's scheme) and any behaviors existant in the organism's repertoire which might be useful in later shaping. The studies reviewed appear not to be systematic in this step, as could be expected.

The sequencing of SDs and reinforcement for shaping, Barlow's step (4), is subject to the criticisms raised above, in that individuals are likely to vary, with regard to what SDs exist in what strengths in their repertoires, and reinforcers may be of varying potentials for shaping behavior. In the studies reviewed, the assumption generally appears to be made that the reinforcement of being correct or receiving a good grade can be used effectively for all students. This and related empirical questions are treated in the concluding section. Leaving aside this issue,

the methods of shaping, as outlined above in the description of the laboratory procedures do appear to be used, in that "better" performances are required before reinforcement is administered in a situation where it had previously been given. Lloyd and Knutzen (1969) appear to well specify the use of this procedure. These authors also appear to specifically use the second half of Barlow's fourth step, bringing the behavior under the control of SDs in the individual's usual ecology, better than the other authors. This process has been termed "weaning" in the descriptions presented above.

Barlow's fifth step does not appear to have been systematically considered in the work reviewed. The intrinsic reinforcement and maintenance of the newly acquired operant is essentially the notion that the skills acquired in the particular course will be maintained in strength in other courses and outside the classroom. Skinner has suggested that this process may also be a function of the scheduling of reinforcement (cf., p. 13, above).

Conclusion: Implications for the Future

Although the literature discussed in the preceding section appears to leave many issues unexplored and suffers from poor methodology, some positive observation may be in order. With the current demands of society on educational systems, the time-effectiveness measures of teachers and techniques have become critical. Demands on and cost of education appear to have far exceeded the "supply." If the application of operant techniques to education can help to alleviate this situation, either by increasing effectiveness of teachers and education or by reducing educational costs (by whatever measures either is to be judged), then there is a great need for research into and application of these procedures (cf., Williams, 1967; Gilbert, 1969; Malott & Svinicki, 1969).

The need for operant techniques in college application would appear to be even greater than for general education, if judged by the standards suggested in the preceding paragraph. The logic of one man (a special man, to be sure) and his preference for such an approach is evident in the following:

> In maximizing the student's success, programed instruction differs from so-called trial-and-error learning where the student is said to learn from his mistakes. At best he learns not to make mistakes again. A successful response may survive, but trial-

> and-error teaching makes little provision for actually strengthening it. The method seems inevitably committed to aversive control. For the same reason, programed instruction does not closely resemble teaching patterned on everyday communication. It is usually not enough simply to tell a student something or induce him to read a book; he must be told or must read and then be questioned. In this "tell-and-test" pattern, the test is not given to measure what he has learned, but to show him what he has not learned and thus induce him to listen and read more carefully in the future. A similar basically aversive pattern is widespread at the college level, where the instructor assigns material and then examines on it. The student may learn to read carefully, to make notes, to discover for himself how to study and so on, because in doing so, he avoids aversive consequences, but he has not necessarily been taught. Assigning and testing is not teaching. The aversive by-products, familiar to everyone in the field of education, can be avoided through the use of programed positive reinforcement (Skinner, 1965, pp. 14-15).

With the apparent need for the application of operant techniques to higher education, it is disappointing to note what has been accomplished.

It appears too early in the "data collection" to appraise the application of operant principles to the college classroom. However, the "pilots" of McMichael and Corey (1969) Lloyd and Knutzen (1969) and the others are encouraging. Some speculations as to the future and some possibilities of why the application of operant principles in higher education has not progressed more rapidly are now discussed.

> Teaching is the expediting of learning. Students learn without teaching, but the teacher arranges conditions under which they learn more rapidly and effectively. In recent years the experimental analysis of behavior has revealed many new facts about relevant conditions. The growing effectiveness of an experimental analysis is still not widely recognized, even within the behavioral sciences themselves, but the implications of some of its achievements can no longer be ignored (Skinner, 1965, p. 6).

In spite of Skinner's conviction and in spite of the needs noted previously, operant principles appear not to be widely applied to higher education. Some possible reasons have been suggested and some other possibilities are apparent.

Williams (1967, pp. 378-379) has emphasized the large capital investment required for the "hardware." However, operant principles can be applied without utilization of expensive "hardware" (i.e., teaching machines). Investment of time and effort on the part of "educational engineers" (teachers) are great, but only initially.

Two, more compelling, reasons for the failure to utilize operant procedures in higher education may be suggested. First, it does not appear that the literature on operant research in the laboratory has had wide circulation among educators. This lack of familiarity with operant principles may have resulted in few professors, in disciplines other than psychology, taking the interest

or initiative to become familiar enough with this body of knowledge to be able to apply it. Wide dissemination of the basic operant principles and their channels of application may meet the problem. Secondly, there appears to be a "tradition" in education which opposed "manipulation" of individuals; part of the aim of American education is to produce "responsible, thinking" citizens. The operant approach has been attacked on such grounds, that it allows the subject no "freedom." This complex issue is more appropriately considered elsewhere (cf., e.g., Skinner, 1966).

In spite of the apparent sparseness of the research, and in spite of the difficulties evident in the application of operant techniques to higher education, some authors have stressed its potential. Gilbert (1969) has concluded:

> As learning methodology, programed instruction promises to relieve the teaching profession of some of the drudgery that precludes a creative approach to teaching. Effective programed instruction actually represents the preservation of good teaching. The many real benefits from use of programed instruction cannot help but accrue to all providers and all consumers of education--in fact, to all human beings concerned with the needs of education, in our own country and throughout the world (pp. 239-240).

A similar sentiment is reflected by Jacobson (1962-1963, pp. 51-52) and Skinner (1965) offers a somewhat novel addition to this viewpoint.

> Confidence in education is another possible result of an effective technology of teaching. Competition between the various cultures of the world, warlike or friendly, is now an accepted fact, and the role played by education in strengthening and perpetuating a given way of life is clear. No field is in greater need of man's most powerful intellectual resources. An effective educational technology based upon an experimental analysis will bring it support commensurate with its importance in the world today (p. 19).

The conviction of those working with the application of the principles of operant conditioning based on the experimental analysis of behavior is perhaps typified by the following:

> It is always tempting to argue that earlier ideas would have been effective if people had only paid attention to them. But a good idea must be more than right: it must command attention; it must make its own way because of what it does. Education does not need principles which will improve education as soon as people observe them; it needs a technology so powerful it cannot be ignored. No matter how insightful the anticipation of modern principles in earlier writers may seem to have been, something was lacking--or education would be much further advanced. We are on the threshold of a technology which will be not only right but effective (Skinner, 1965, p. 16).

This writer, for one, hopes Skinner's prediction is correct. There are, however, difficulties apparent in operant theory itself which may have hampered the systematic application of operant tech-

niques in the college classroom. After reviewing social learning theory (SLT) in the next section, specific suggestions taken from SLT for using the operant model in the college classroom are discussed.

The Social Learning Model

Having considered the application of the principles of operant conditioning to college learning as delineated in the previous section, one may conclude that there are serious limitations to this orientation. For instance, if a college instructor wishes to manipulate the appropriate contingencies of reinforcement in the classroom, he needs to know what constitutes reinforcement for a given student, and, ideally, such knowledge requires information about his individual history of reinforcement. Similarly, to apply the principles of operant conditioning, it is essential to establish the "base line" of behavior or more technically, the probability of occurrence of a specific behavior to be conditioned in the student. The same assessment is required for classes of behavior in the repertoire of the student. Such limitations, it may be suggested, present serious difficulties for the practical use of the principles of operant conditioning in the college classroom. The assessment of each student, the requirement of which is noted above, would require large expenditures of personnel time, money, and equipment. In the present educational system, it would

appear that the required assessment using strictly operant techniques is likely never to occur.

Variables like "history of reinforcement" and individual reinforcement contingencies, as well as response hierarchies, can be considered as lying in the domain of the "personality" sub-area of psychology (Jessor, Graves, Hanson & Jessor, 1968, pp. 85-89). Rotter's (1954, 1955, 1960, 1966) social learning theory (SLT) perhaps provides a basis for meeting the limitations of applications of operant principles to the college classroom, in that the primary concepts of SLT are intended to evaluate what constitutes reinforcement for the individual, as well as what contingencies of reinforcement are in operation for the individual. SLT is directed at the complex or personality level, rather than derived from principles developed in simple situations. In this section of the paper, then, the basic formulations of Rotter's theory are presented and suggestions for application of this conceptual framework to the college classroom are discussed. The orientation is primarily theoretical in that SLT does not appear to have been directly applied to the processes of learning in the college classroom. In addition, the appropriate measures have not been formulated. Such an application would, however,

appear to be potentially fruitful; a suggested research program is developed below.

Rotter's Orientation

Rotter, at the Nebraska Symposium on motivation (1955), addressed the problem that learning theorists generally do not treat the issues raised above, that is, the measurement of what constitutes reinforcement or what contingencies are operating for the individual. It is argued that knowing the external environment is not sufficient for prediction of individual behavior; the "psychological situation" must also be considered. Rotter states that, "any attempt to predict precisely or specifically what the human organism will do, requires a knowledge of the cues present, internal or external, and the acquired meaning or learned values that these cues have for the organism" (1955, p. 245).

Rotter goes on (1955, pp. 245-254) to review theoretical positions which have treated the "psychological climate" and concludes that this consideration is never more than implicit. In this regard, Brunswik's approach is noted as an exception. In other specific research areas the "psychological situation: has been considered somewhat more explicitly. The role of anxiety

in student performance (1955, pp. 251-252) and the role of experimenter, examiner, or teacher bias (1955, pp. 249; 251-252; cf., Rosenthal, 1966, E-effect) are noted by Rotter as such research areas. He, however, concludes that the consideration of the "psychological situation" generally has been limited to personality theorists and social psychologists; the importance of the psychological situation in learning theory is stressed by Rotter:

> There are two basic aspects to the prediction of learned behavior. One deals with the individual's past experience, from which we must abstract constructs or variables of different levels of generality for different purposes and we attribute these to the individual or consider that he carries these around with him. The other is the present, meaningful environment, psychological situation, or what Lewin has called the "life space." From this latter variable the psychologist must also abstract constructs at different levels of generality for different purposes in order to predict behavior (1955, p. 249).

Specification of Rotter's Theory

Rotter has specified the role of the psychological situation in the prediction of human behavior with the formal statement of functional relationships. However, before considering these, some basic definitions are treated.

Internal and external cues. In the discussion above of this general orientation, it was noted that knowing both internal and

external cues is considered essential in order to predict behavior. The definition of these variables has implications behond the common-sense meaning:

> By internal cues I mean that the individual is responding to stimuli conditions, arising in the body, with learned associative meanings, such as to a parched throat, or a pain in the region of the stomach. By external cues I refer to any aspect of the individual's environment, outside of the body, to which he is responding at any given time, and which for him has acquired meanings as a result of previous experience. A cue then is a psychological stimulus (Rotter, 1955, p. 251).

It would appear that in this use "cue" is a somewhat broader concept than the "stimulus" of operant theory (although, cf., Staats & Staats, 1963).

The definition of the other basic concepts of SLT are most efficiently treated as they appear in the statement of the functional relationships of the theory. SLT first was stated comprehensively in the context of clinical psychology (Rotter, 1954);

Social learning theory has been characterized in the following way:

> The fundamental concepts in Rotter's social learning theory are the following: (1) <u>expectation</u> (E), which refers to the subjective probability held by an individual that a specific behavior will lead to the occurrence of certain events or reinforcements; (2) <u>reinforcement value</u> (RV), which refers to the degree of preference for the events or reinforcements which

> are contingently related to behavior; (3) behavior potential (BP), which refers to the likelihood of occurrence of a behavior, or the relative strength of the tendency to respond in a certain way; and (4) the psychological situation (S), which refers to the immediate context of action described in psychologically relevant terms, that is, in terms reflecting the actor's potential perception or interpretation of his confronting situation.
>
> These basic terms generate the following descriptive formula, which constitutes the foundation for prediction or explanation at the personality level: BP = f(E and RV). The formula reads: The potentiality of any behavior occurring in a given situation is some function (probably multiplicative) of (1) the expectation that it will, in that situation, lead to a particular goal and (2) the value of that goal in that situation. Note that the "S" term is implicit in that each of the other terms in the formula is variable or dependent upon the specific properties perceived in the psychological situation. Action, or actual behavior, then, always involves a process of selection or choice, from a repertoire of behaviors, of that behavior with the highest potential for leading to gratification in a given context (Jessor, et al., 1968, pp. 85-86).

The four terms of this general expression require elaboration and lead to some other functional relationships.

Expectation. What Jessor et al. have termed "expectation" was in Rotter's original formulation "expectancy" (E). "Expectancy may be defined as the held by the individual that a particular reinforcement will occur as a function of a specific behavior on his part in a specific situation or situations" (Rotter, 1954, p. 107; 1955, p. 255). Additionally, it is pointed out that

expectancy is theorized to be independent of the reinforcement's value or importance to the individual. The concept of expectancy is important also in moving from prediction of specific events to prediction or explanation of classes of behavior, as is elaborated below.

Reinforcement Value. Originally this concept was defined "ideally," limited to external reinforcement (Rotter, 1954, p. 107). In subsequent presentations of the theory this qualification was dropped and reinforcement value (RV) defined "as the degree of preference for any reinforcement to occur if the possibilities of occurrence of this and other reinforcements are equal" (Rotter, 1955, p. 255). It is clear that the referent of this concept is the individual and not experimenter-defined events in the ecology, the nature of the reinforcement concept in operant theory.

Behavior potential. The third basic concept of SLT and the one which provides the basis for the prediction of behavior is behavior potential (BP). This is defined "as the potentiality of any behavior's occurring in any given situation or situations as calculated in relation to any single reinforcement or set of

reinforcements" (Rotter, 1954, p. 105; cf., 1955, p. 255). It is noted that ultimately the evaluation of the potentiality for the occurrence of any specified behavior may be based on its actual occurrence in a given situation where alternative behaviors are possible. BP thus is a relative measure, being described only as weaker or stronger than other potential behaviors present in that situation. This relativity would hold also if the potential for the same behavior were determined in several different situations (Rotter, 1954, p. 105). That is to say that the obtained BP's would be ordered relative to each other for each different situation.

Psychological situation. One concept is implicit in all the functional relationships presented below, the importance of which has been stressed by Rotter. "Perhaps one of the greatest weaknesses of current psychological theorizing and practice has been its failure to deal analytically with the situations or contexts in which humans behave" (Rotter, 1954, pp. 110-111). The psychological situation (s) functions to provide cues by which the individual may determine which reinforcements he may expect to follow which behaviors (Rotter, 1955, p. 256). More specifically,

> We mean by s a psychological situation or any part of it to which the individual is responding. Like Lewin

> (1951) and Kantor (1924), we define a situation as that which is experienced by the subject with the meanings the subject gives it. The situation must also be describable in objective terms for scientific purposes. We do not let the matter rest with the statement that for each person the situation may have different meanings, since it is necessary to describe in some communicable way what it is that has different meanings for various persons (Rotter, 1954, p. 111).

The three variables defined above are viewed as functionally related in the context of s. Hence, they provide a basis for predicting human behavior at the most simple level and, with reformulation, at the complex level, classes of behavior.

Predicting behavior. At the most simple level (i.e., a single behavior), expectancy and reinforcement value are combined, in the context of the psychological situation, to yield behavior potential. Formally, this relationship is stated:

$$B.P._{x,\ s_1,\ R_a} = f(E_{x,\ R_a,\ s_1}\ \&\ R.V._{a_1, s_1}).$$

Verbally, this relationship is: the potential for the occurrence of a given behavior (x) in a specific situation (1) in relation to a given reinforcement (a) is a function (probably multiplicative) of the value of that reinforcement in that situation and of the expectancy for the occurrence of the reinforcement a following the given behavior in that specific situation (Rotter, 1955, p. 255; 1954, p. 108; 1960, p. 302).

This initial formulation is of limited usefulness, however, in the prediction of behavior because it takes into account only a specified reinforcement and no other possibilities. In order to predict the potential of all the possible behaviors occurring in situation 1, a set of BP's must be obtained, each limited to a specified reinforcement. This logic generates the following formulation: $B.P._{X, S_1, R(a-n)} = f(E_{X, S_1, R(a-n)} \ \& \ R.V._{(a-n)})$, which can be described verbally as the potential of the occurrence of a given behavior (x) in a specified situation (1), considering all the potential reinforcements relevant to the individual, is a function of the expectation that these reinforcements (a to n) will occur in the given situation and the values of these reinforcements (Rotter, 1954, p. 109).

In order to predict behavior at a more general level in a variety or group of situations, the formula for behavior potential is generalized: $B.P._{(x-n)\ S_{(1-n)}\ R_{(a-n)}} = f(E_{(x-n)\ S_{(1-n)}\ R_{(a-n)}} \ \& \ R.V._{(a-n)\ S_{(1-n)}})$. This is described by Rotter:

> The potentiality of the functionally related Behaviors x to n to occur in the specified Situations 1 to n in relation to the potential Reinforcements a to n is a function of the expectancies of these behaviors leading to these reinforcements in these situations and the values of these reinforcements in these situations (Rotter, 1950, p. 302; cf., 1954, pp. 109-110).

This formula is simplified in the following expression: NP=f(FM & NV) (Rotter, 1960, p. 303). This introduces three simplifying and more general variables than used in the preceding formula. Need potential (NP), freedom of movement (FM), and need value (NV) are defined in the following description of this functional relationship: "The potentiality of occurrence of a set of behaviors that lead to the satisfaction of some need (need potential) is a function of the expectancies that these behaviors will lead to these reinforcements (freedom of movement) and the strength or value of these reinforcements (need value)" (Rotter, 1954, p. 110). Rotter has emphasized that the psychological situation is implicit in this formula (1960, p. 303).

Rotter has further elaborated the theory and further specified the concepts of SLT (1954). In addition, he has indicated how SLT can be brought to bear in particular applied areas (clinical, 1954; personality testing, 1960). However, since these do not appear to bear directly in this effort to conceptualize college learning, only one additional concept is considered.

Internal-external control. In later development of SLT and in Rotter's research, the concept of internal versus external control of reinforcement (I-E) has received emphasis. This con-

cept has been most fully developed and a relevant program of research reported in a monograph (1966). I-E is in a sense a further generalization of the predictive function of the theory as can be seen in definition provided by Jessor et al. (1968). I-E is the "generalized orientation or expectation that the outcomes of one's behavior are contingent upon what one does (internal control) as opposed to being determined by outside forces, such as powerful others, or impersonal random forces such as luck, fate, or chance (external control)" (italics in the original, p. 104).

With the basic conceptualizations of Rotter's SLT in hand, a consideration of its potential role in research on college learning processes can be undertaken. In what follows some suggestions as to the potential use of SLT in characterizing and researching learning in the college classroom are described.

SLT and Learning in College

The potential contribution of SLT to research on conceptualization of college classroom learning processes is in its specification of individual differences inherent in the concept of psychological situations. The most efficient application of any reinforcement paradigm to such complex human learning would

appear to require elaboration as to how the variables of stimuli and reinforcements effect individuals differently. This can be elaborated in considering the potential role of each of the variables of SLT in conceptualizing the learning processes of the college classroom.

The concept of reward value provides perhaps different potential information for predicting human behavior than the experimentally controlled reinforcement. Recalling that RV is the extent to which an individual prefers reinforcements contingent on his behavior, it can be suggested that experimenter-(teacher-) defined reinforcements will differ in their effect in controlling students' behavior. As an example, some students will "work" best for grades, other for praise, and still others for freetime. For the teacher to manipulate only grades, for instance, (i.e., to "contract" for the amount of work to be completed by the student) would appear a less efficient way to handle a <u>class</u> of students than to determine what reinforcements are preferred by individual students. The RV concept of course broadens to need value in considering classes of functionally related reinforcements (goals).

It would appear that determining the RV or NV for an individual student perhaps provides the same functional information as is essential in specifying or controlling the history of reinforcement of the individual student as is noted above (p. 25). The difference between these two approaches would appear to be in the method of measurement (or manipulation) by the teacher.

As with RV and history of reinforcement, a parallel between expectation and the contingencies of reinforcement can be drawn. E, the individual's subjectively held probability that a particular behavior will be followed by the occurrence of a specified event or class of events (reinforcements), can be viewed as the individual's appraisal of the contingencies of reinforcement in his ecology. Whether such contingencies are chance-controlled or they are personally controlled indicates the role of the I-E variable of SLT. The E variable is generalized to sets of behaviors and goals as the mean expectancy or freedom of movement.

An example of a classroom situation may help clarify the relationship suggested between E and contingency of reinforcement. The I-E concept is also suggested in this example. If a student perceives that the grade he will receive for a research

report is a function of how well he approximates writing a paper acceptable for publication, it can be predicted that he will respond differently than if he perceives that his grade is determined only by the instructor's whim. It is suggested that this is so, irrelevant of the actual contingencies of reinforcement. To specify this point: it is being suggested here that for mature human subjects (hopefully students) in complex situations of learning, the individual's expectations of reinforcement will be a better predictor of behavior than the actual contingencies of reinforcement. However, through learning it can be suggested that expectations and contingencies of reinforcement may, in general, become very similar, if not identical.

The probability of the occurrence of a given behavior, that is the relative response tendency (BP) strength, appears conceptually similar to the notion of response heirarchy (cf., Staats & Staats, 1963, pp. 101-107). The concept of response hierarchy is an extension of basic operant principles. It can be taken to suggest that for classes of functionally related behaviors, one behavior has a greater likelihood of occurrence in a given situation than another behavior in the same class. This parallel is most explicit in considering that the relati-

vity of the strength of the tendency to respond in a certain way is with other behaviors. When BP is broadened as need potential, the probability of occurrence of a set of functionally similar behaviors, the two concepts would appear to be identical. The determination of response hierarchies or of NP would appear to yield the same information, at least conceptually.

A summary comment is in order for this section: In this treatment of Rotter's social learning theory, the approach has differed somewhat from the previous approach to operant conditioning. In the operant conditioning section, relevant research was reviewed; none was available for applying SLT to the classroom. However, to the author, these two theories do not appear to be antagonistic. On the contrary, they appear to be complementary, as has been stressed above. SLT would appear to have potential contribution to reinforcement paradigms in general, and, in particular, for conceptualizing learning processes in the college classroom, if in no other way than notational. However, a broader contribution has been suggested above.

Summary and Conclusions

Based on the thrust of the existing literature, the paradigm initially followed in this paper to characterize learning in the college classroom is that of operant conditioning. The intent in this paper is to increase the effectiveness of learning in the college classroom through the more efficient use of operant techniques. Some apparent difficulties, impairing the efficiency of the application of this paradigm in a complex situation, have been alluded to above. In addition, it has been suggested that social learning theory may hold some potential solutions for these problems in specifying reinforcers and contingencies. In this concluding section these matters are more concisely formulated and the nature of research relevant to these issues is indicated.

The two major difficulties in applying the operant approach in the college classroom would appear to be in assessing (prerequisite to controlling) the contingencies of behavior and reinforcement and in manipulating the relevant reinforcers (steps 3 and 5 in the general operant procedure outlined above). In complex human behavior, it is difficult (i.e., e.g., "unethical") to control the organism's history of reinforcement, or even the most recent history, such as depriving a rat of water. In addi-

tion, recording such history would appear to present insurmountable (at present) problems when the time period is around 20 years. The difficulty in manipulating relevant reinforcers is similar to the preceeding one for complex, human behavior: in order to manipulate the reinforcers, one must determine what constitutes a relevant reinforcer. The E knows the relevant reinforcer of the bar press operant if the rat has been food deprived for 36 hours, and thus can manipulate this reinforcer. Can a teacher, however, be so confident that the promise of an "A"-grade is the relevant reinforcer for the operant of writing a research paper if the student has been "A"-deprived for two semesters?

As noted previously, the experimenter or teacher manipulation of relevant reinforcers is dependent upon their specification. In the rat (or in simple behavior) the relevant reinforcers are operationally "defined" when the experimenter deprives the organism, a situation unlikely to be duplicated in complex, human behavior. Two basic concepts of social learning theory may provide a basis for assessing the relevant reinforcers for individual students in complex learning situations. Expectancy is the individual's (subjective) probability that a given reinforcement will occur as a function of his emitting a particular

behavior in a particular situation. This concept also provides a basis for assessing what are the individual's perceptions of the contingencies of reinforcement. Reward value, on the other hand, is the concept which provides the basis for determining the relative strength of reinforcers for the individual. Thus, it may be an indication of what reinforcer should be manipulated by the teacher in order to control the student's behavior.

Two ideas have been raised here which should be further stressed. The notion is implicit that what the student reports as the contingencies of reinforcement (his expectancy) is more useful in the control of behavior (learning) than the "actual" or teacher-defined and -manipulated contingencies. Such an orientation is consonant with the approach of social learning theory. However, operant theory might be taken to suggest the contrary orientation to the question of the individual's awareness of the contingencies operating in his learning (cf., e.g., Greenspoon, 1955) that reinforcers may operate outside of awareness. Research is required to resolve this apparent difference in the two theories. The question is whether or not the individual's perception of the contingencies of behaviors and reinforcements (or at least his report of these) is relevant to the

effectiveness of learning. In fact, if student-reported and teacher-defined contingencies differ at all is an empirical question. The second notion is that what events a student perceives as reinforcing may nor correspond in "value" (i.e., their effectiveness for the control of behavior) to the teacher-defined and -manipulated events. In fact, the student may not perceive as reinforcing at all what the teacher manipulates. The question is again which set of events or (reported) perceptions leads to better control, if they are different at all.

Specification of Research Questions and Suggested Methods

In specifying what appears to be the critical research questions, the orientation taken below is to focus on the apparent deficits in the operant paradigm and to suggest how the concepts and methods of SLT may be utilized in providing the information necessary for effective application of operant techniques in the college classroom. The most important question for college teaching raised above would appear to be that of the perception of reinforcers in the teaching process. That is to say, do students perceive the same events as reinforcing as do teachers in the teachers' effort to control the classroom and academic behavior of college students?

At the outset it should again be noted that, in the terms of Rotter's theory, this question involves the assessment of a student's psychological situation. In the methods typically used in SLT, a questionnaire for the expected outcomes or consequences of a set of behaviors is developed. Adams and Ulehla (1969) have used a method for assessing social learning variables in the framework of the theory of signal detectability. This measurement model can be combined with an orientation toward social perception (such as Gibson's and Brunswik's), which focuses on the individual's subjective perceptual parallels to the events of the ecology. Through Brunswik's notion of representative design the complexity and real nature of the ecology is stressed. That is to say that stimulus situations are used as they exist in the natural ecology, rather than as they are delimited and simplified typically in the laboratory.

This approach to the measurement of social perception yields unitless, ratio-scaled measures from rating scale data, similar to Thurstone's (1927) approach. In the intended application of this approach to social perception measurement, "stimulus sources" may be read as the events in the ecology of students and teachers which are "considered to be rinforcers" in the college classroom.

The method of development of expected consequences questionnaires is suggested by several authors (cf., e.g., Jessor, et al., 1968).

A second major question is implied in the preceeding paragraphs. This question too, involves differing perceptions of the ecology but is centered around the problem of specifying the contingencies of reinforcement and behavior, or expectancies in social learning terms. That is to say, are the contingencies perceived by the teacher the same as those perceived by students? As an example, does the student perceive his grade to be contingent upon the "knowledge of the literature" demonstrated in his writing of a paper or contingent upon the teacher's whim? For the teacher, is the grade given contingent upon the "knowledge" demonstrated or on the "clarity of expression," the "style," the "form," or some combination of these or upon something else? Clearly, the control of paper writing behavior is in part a function of such perceptions of the relevant contingencies, perhaps more so than the "actual" contingencies. This latter is again an empirical question, but is not the current focus. A methodological approach similar to that outlined for the first basic question would appear productive. That is to say, a questionnaire focusing on the expected consequences of various aca-

demic activities (i.e., the contingencies of reinforcements on student behavior) would be used. Items again would be developed according to the principles of the ecological, functional approach to perceptual measurement. Sampling academic behaviors and their expected consequences from the ecology or what people (students and teachers) perceived of the ecology is required.

These two basic questions suggest supplemental research questions. Having discovered if (and to what extent) teachers' and students' perceptions of the reinforcers relevant to the classroom and academic behavior of college students differ, for example the next question might be to discover which events in the ecology of the college classroom are most useful in controlling the target behavior. In social learning terms, the question is which events of potential use, have the greater reward value for students, within practical (e.g., ethical) limits. Another supplemental question with a closer anchor in the ecology of the college classroom is to determine if the reinforcers and contingencies actually manipulated by the teacher are the same ones the teacher perceives himself to be manipulating. These are only two of many possible questions which would be of experimental potential. The elaboration of these questions and the

appropriate experimental methods should be determined by the answers to the more basic questions raised above.

Having raised the two basic research questions for assessing the utility of social learning concepts in refining the application of operant procedures to the classroom, several other questions of research interest may be generated, some of which have been noted. The basic issue remains: Can the concepts of social learning theory be utilized in complementing the basic operant paradigm for use by college teachers in controlling the academic behavior of their students? Research directed at answering these basic questions should clarify the utility of social learning concepts and methods in the effort to improve the effectiveness of teaching in the college classroom through the use of the operant paradigm.

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Footnote

An effort in which operant techniques have been applied to several college courses is reported by Johnston and Pennypacker (1971) and appeared after this manuscript had been printed. In Johnston and Pennypacker's operationalization of operant principles, students performed verbally in answering questions for each study unit to criterion. Reinforcement (i.e., being correct) was administered immediately by a more advanced student "manager," who also displayed the student's cumulative record. The course grade was determined by the final correct and incorrect response rates. Replications, with variations (e.g., silent written performance) and in various course content areas are also reported.

In spite of conclusions by the authors as to the success of their efforts (e.g., in one course, 66 out of 68 students obtained the criteria), it is apparent that the criticisms noted of the previous research are applicable to the work reported by Johnston and Pennypacker. In fact, the methods they employed are similar to those of Ferster (1968), although Johnston and Pennypacker's (1971) effort will undoubtedly receive a wider reading.

ABSTRACT

The orientation suggested in this paper is that operant theory and social learning theory are complementary. The basic paradigm for the learning process in the college classroom has been taken to be that of operant theory. The difficulty in applying this theory, it has been suggested, lies in the determination of (1) the relevant contingencies of behaviors and classes of events, known as reinforcers, and (2) the reinforcers, themselves, for the manipulation of both in bringing about the specified behavior. The potential of Rotter's social learning theory in meeting these problems may be taken to suggest a program of research; some basic questions of such a program are discussed.